

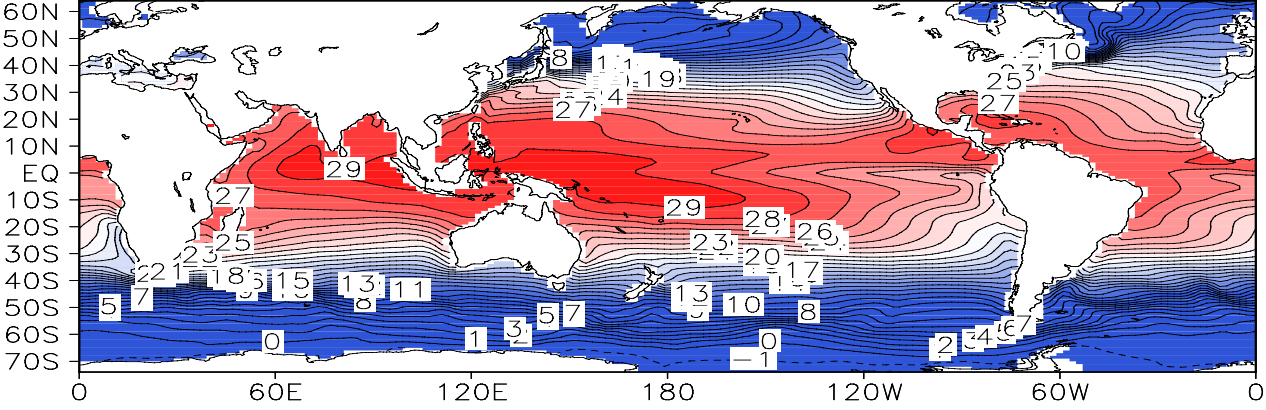
Initialization Strategies for the CFS

Ben Kirtman, Eric Altshuler, Kathy Pegion
George Mason University and the Center for
Ocean-Land-Atmosphere Studies

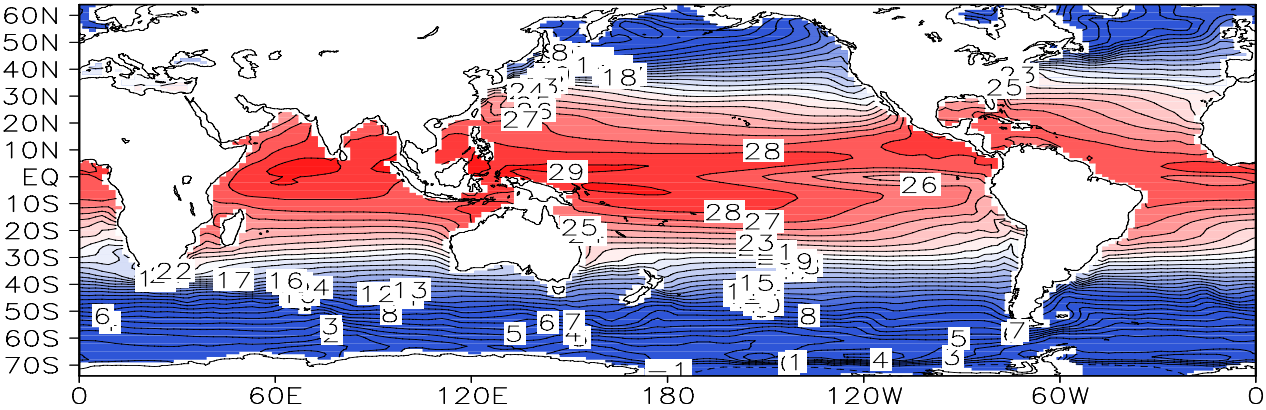
The Initial Condition Problem

- Best State Estimate
 - Data Assimilation in the Separate Component Models
 - Maybe Not Ready to Do the Coupled Assimilation Problem
- Coupled Model Climate \neq Observed Climate
 - Anomaly Initialization
- Coupled “Modes” of Coupled Model \neq Observed Coupled “Modes”
 - Initializing the Coupled Modes
 - Identifying the Coupled Modes: EOFs, SVDs, ...
 - **Context of the Forecast Environment**

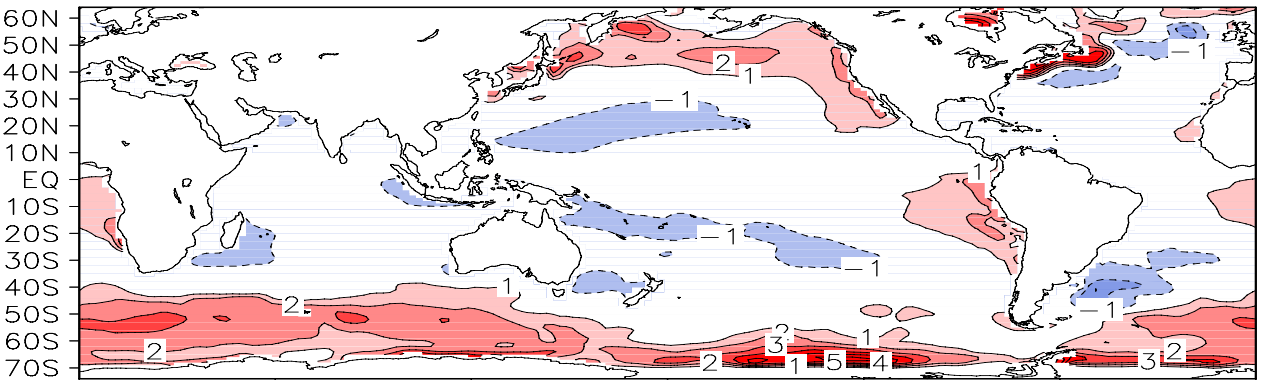
GODAS



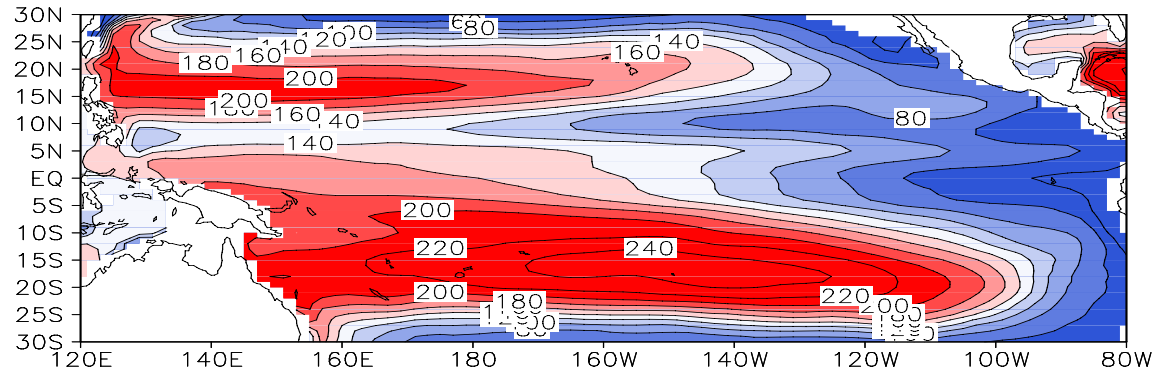
CFS Simulation



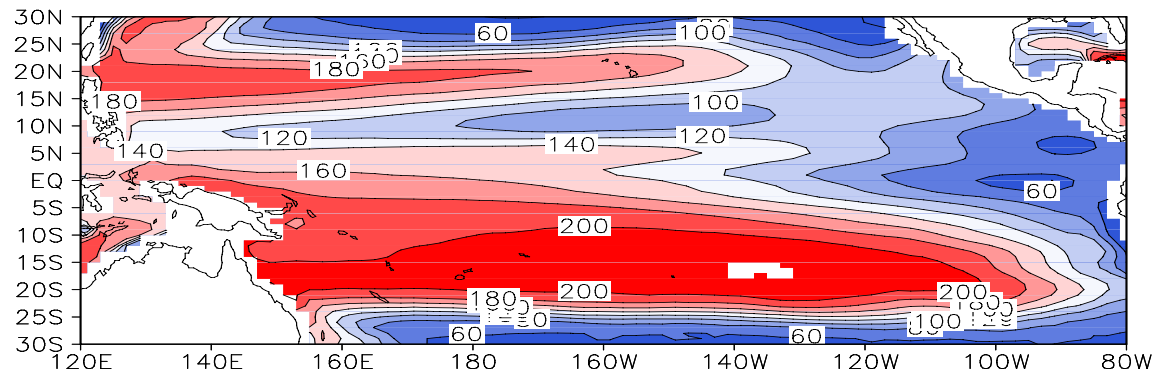
Drift



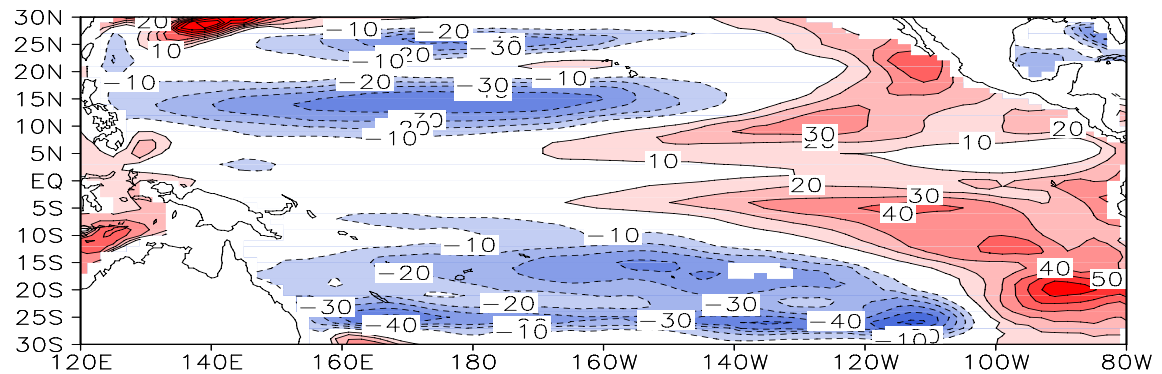
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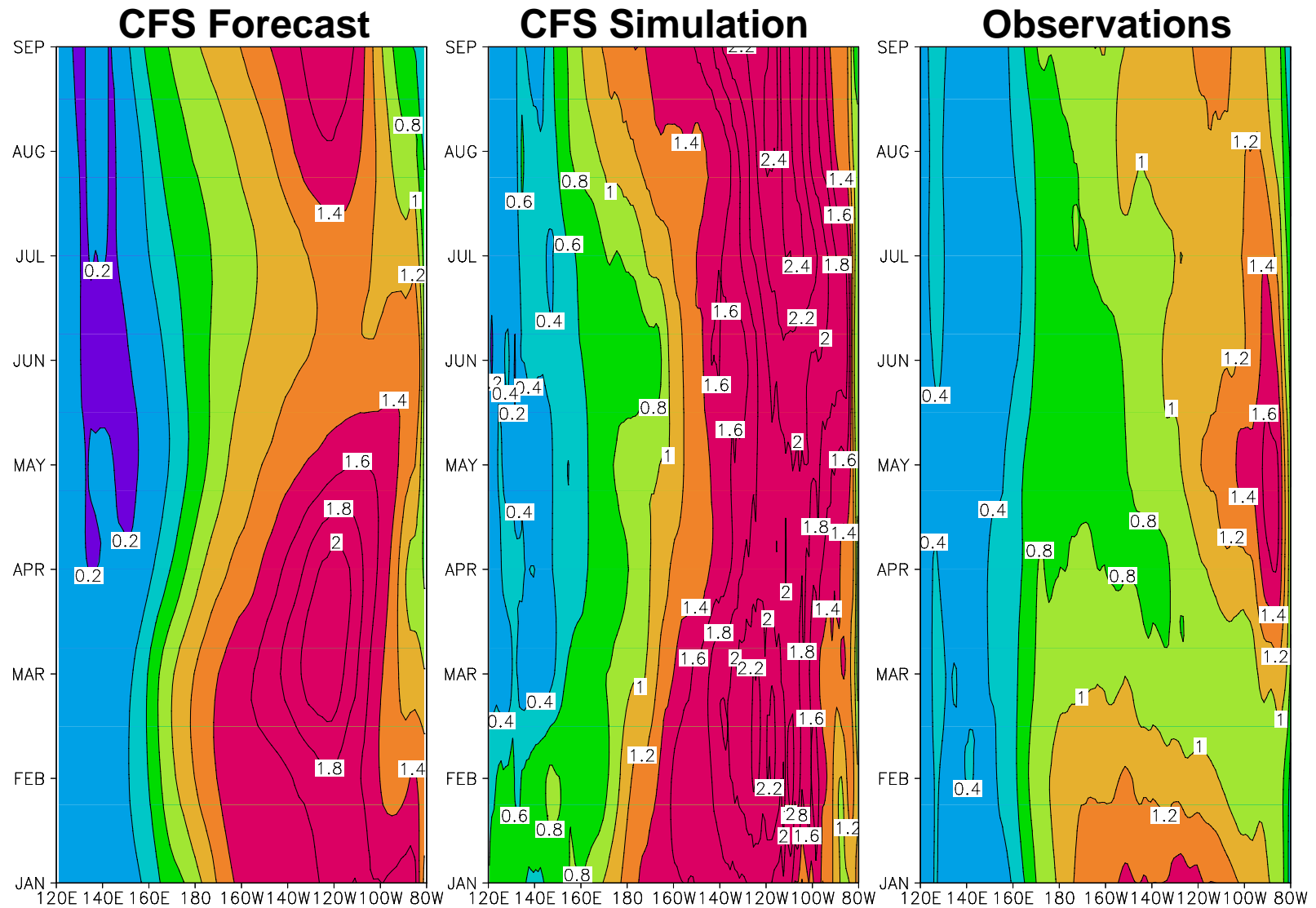
CFS Simulation



Drift



Coupled Ocean-Atmosphere Initialization

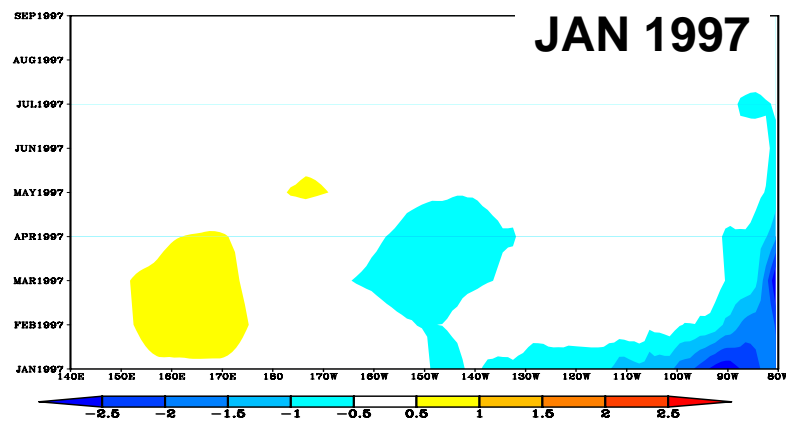
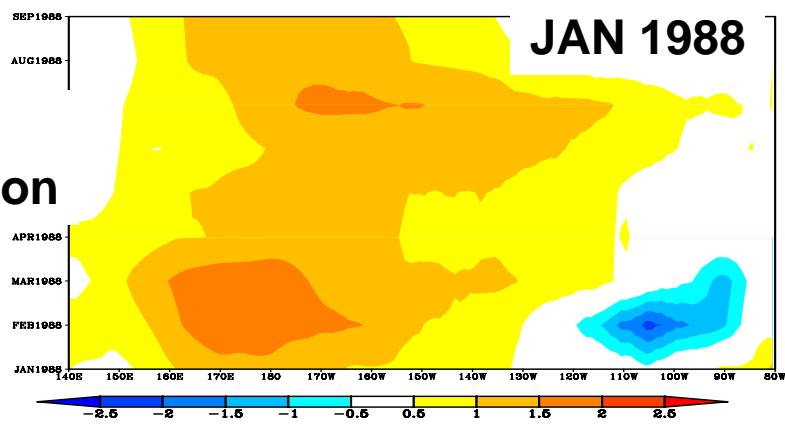


SSTA Standard Deviation as Function of Month

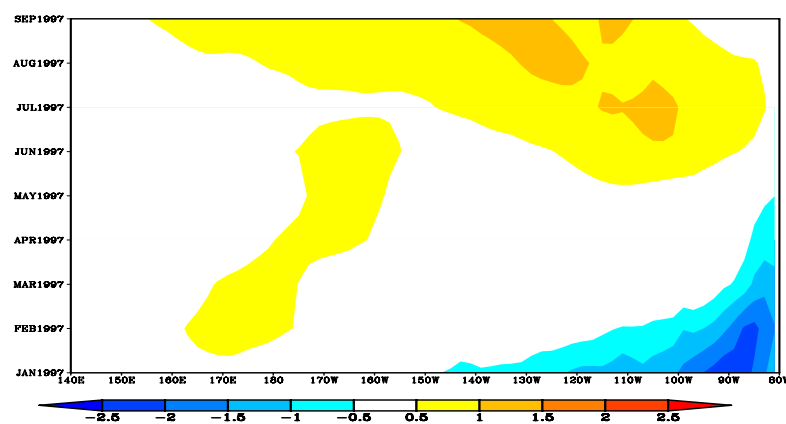
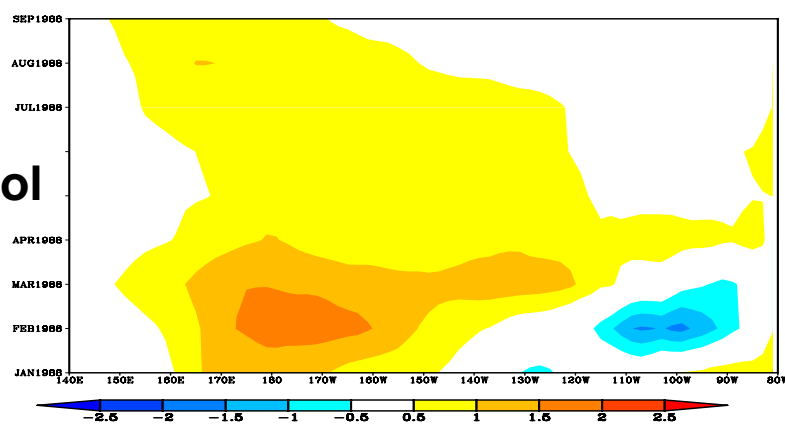
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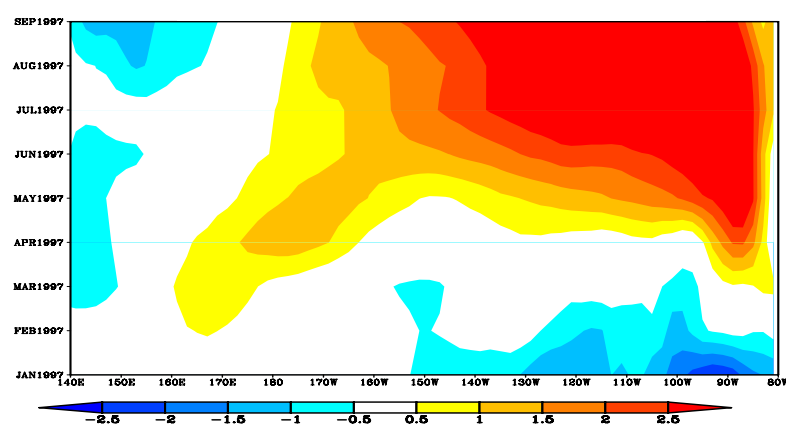
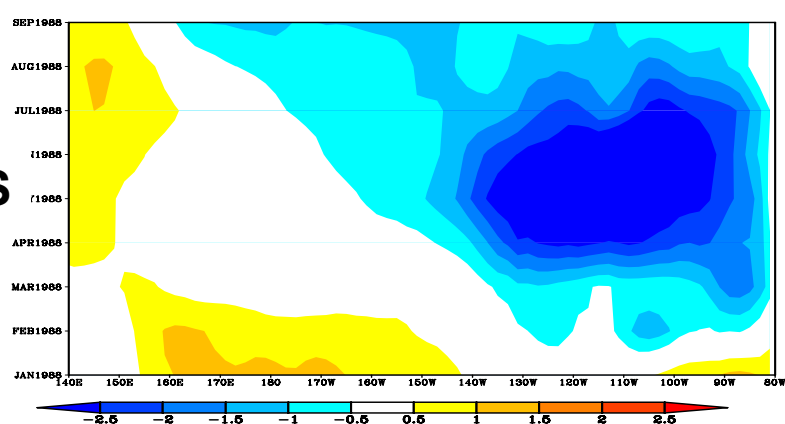
**Anomaly
Initialization**



CFS Control



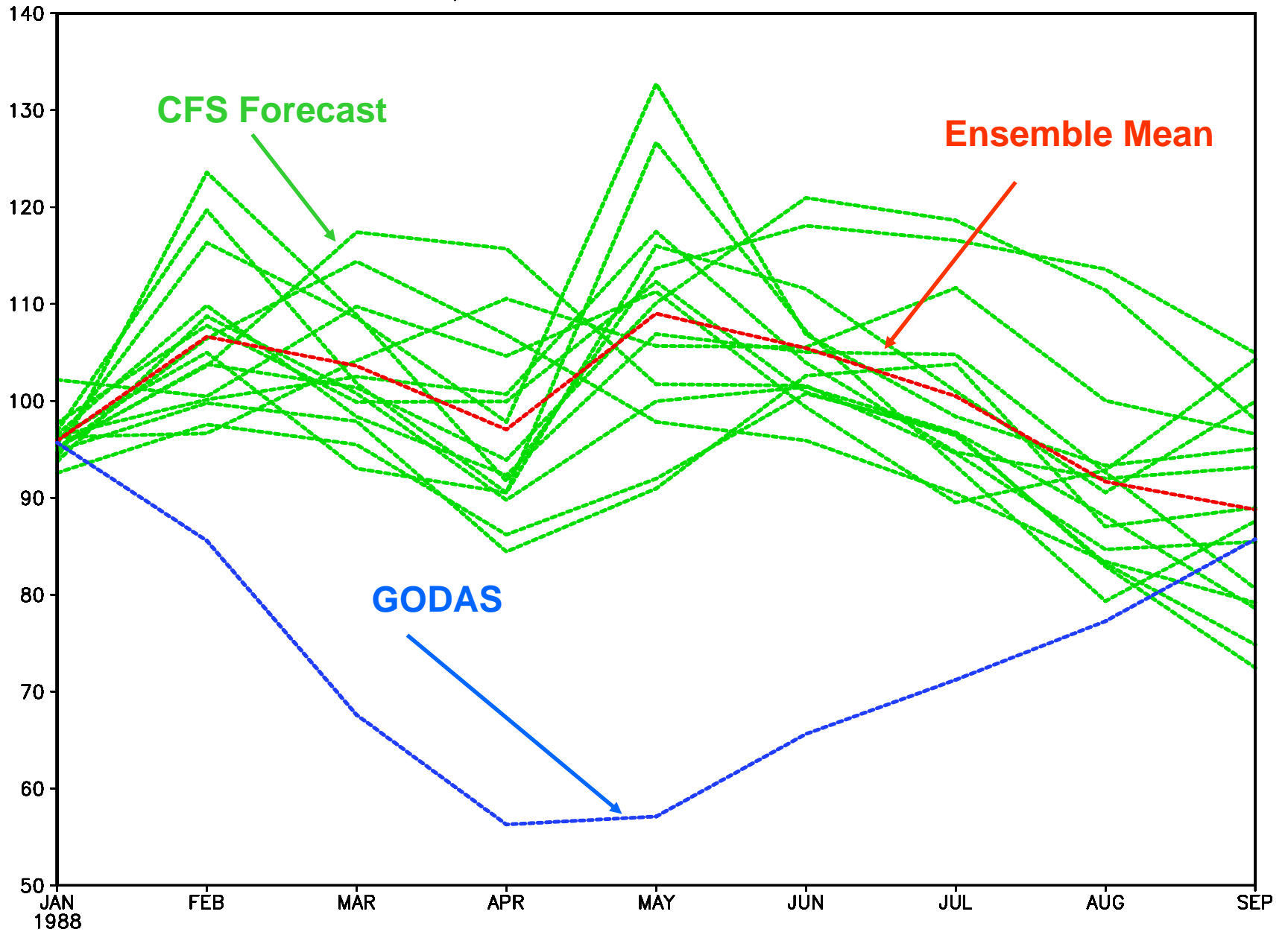
GODAS



Why Did the Forecasts Bust?

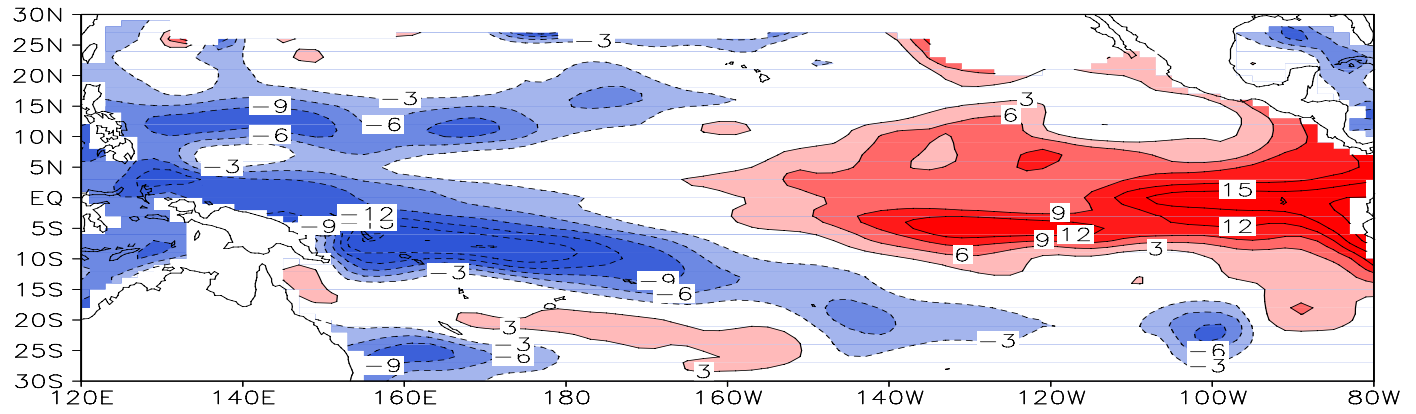
- Predictability Issue
 - Not Enough Ensemble Members
 - What Actually Happened was an Outlier
 - Westerly Wind Burst
- Something *Wrong* with Initial Conditions
 - Anomaly Initialization Did Not Help
 - Coupled Modes of the Coupled Model

Depth of 20C Isotherm

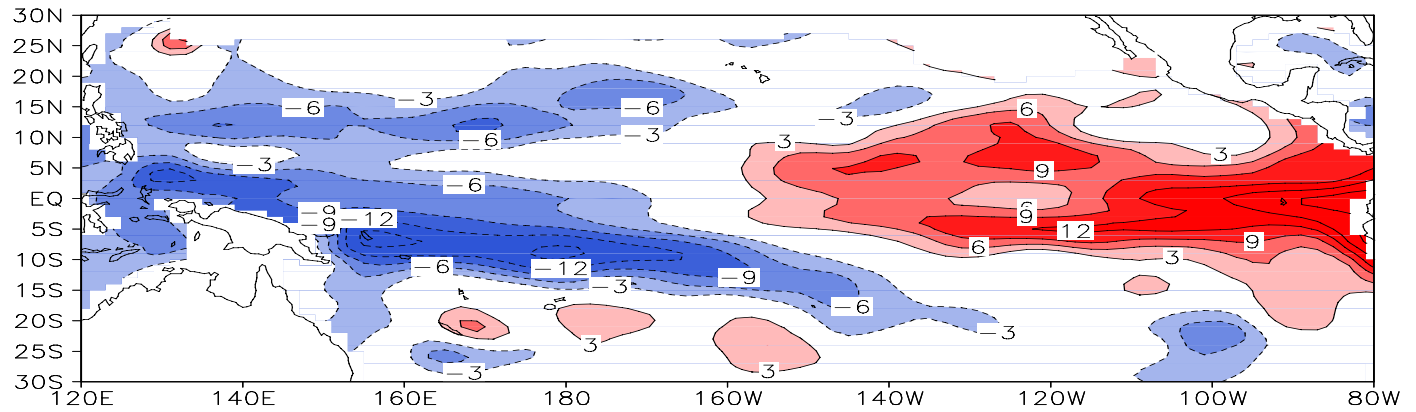


ENSO Precursor Three Month Lead

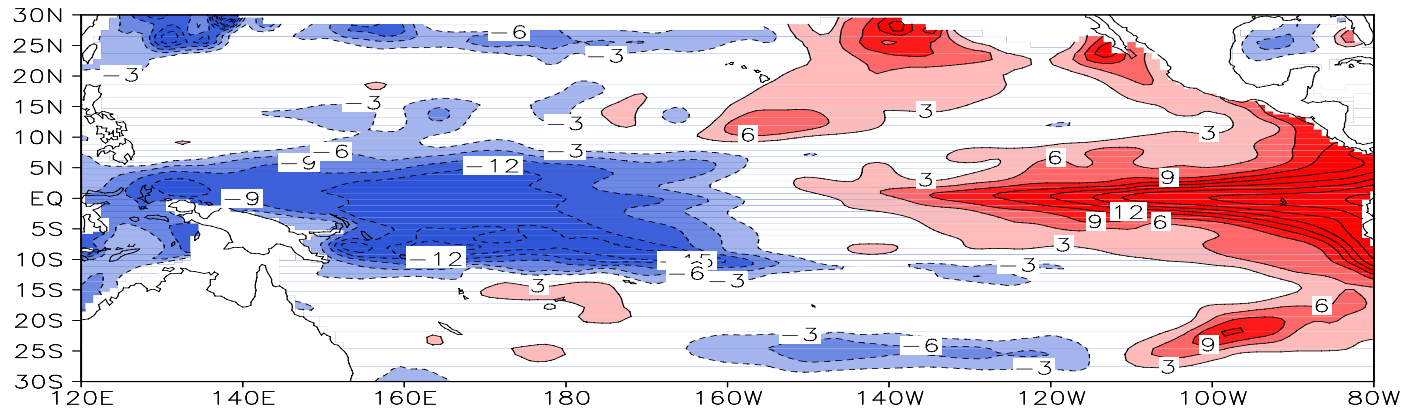
**CFS
Forecasts**



GODAS

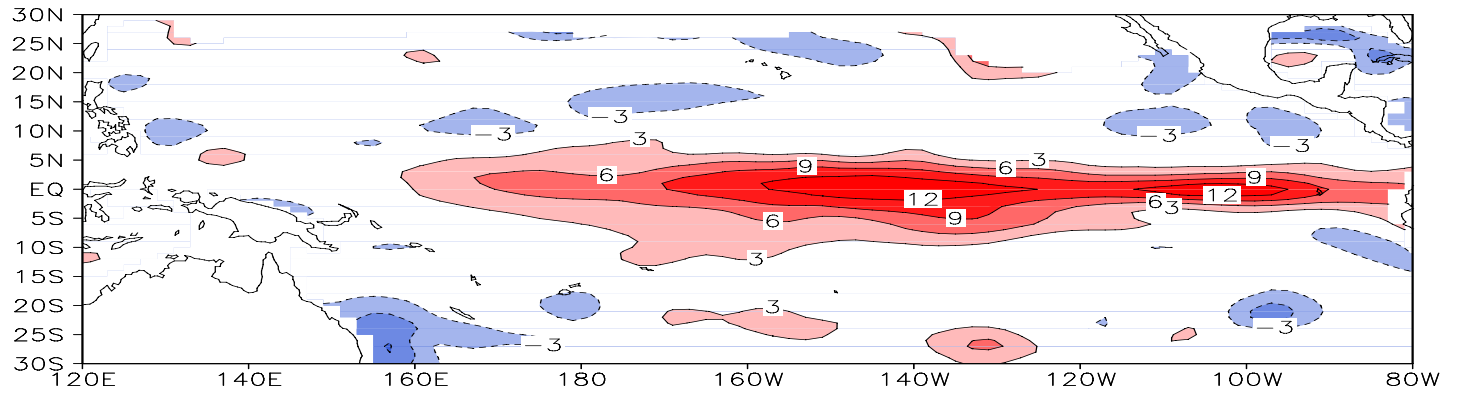


**CFS
Simulation**

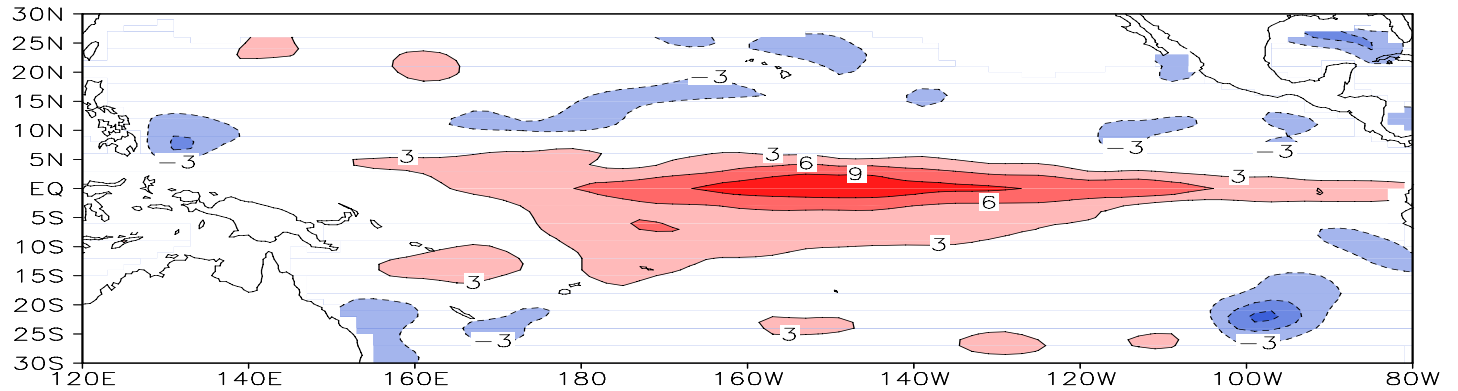


ENSO Precursor Nine Month Lead

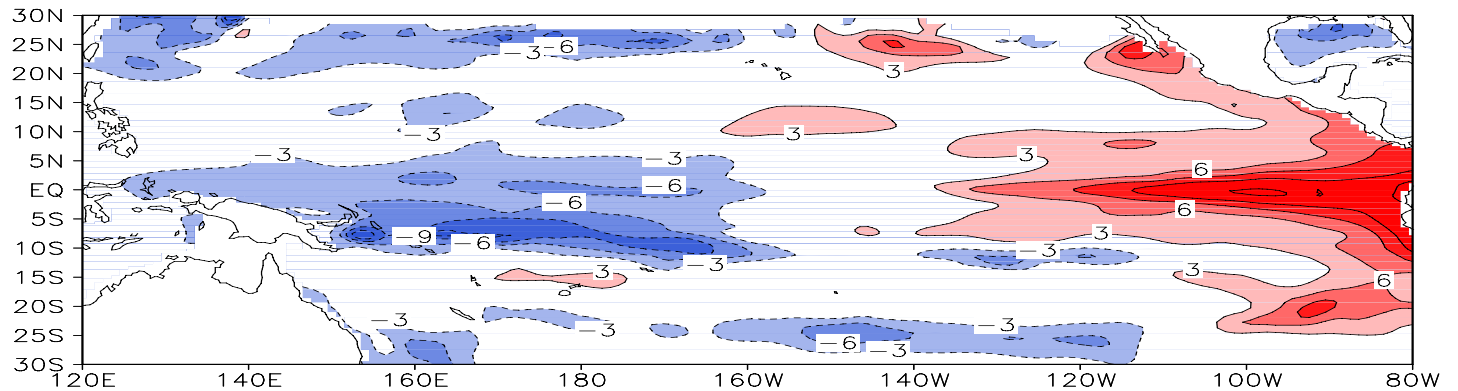
**CFS
Forecasts**



GODAS



**CFS
Simulation**



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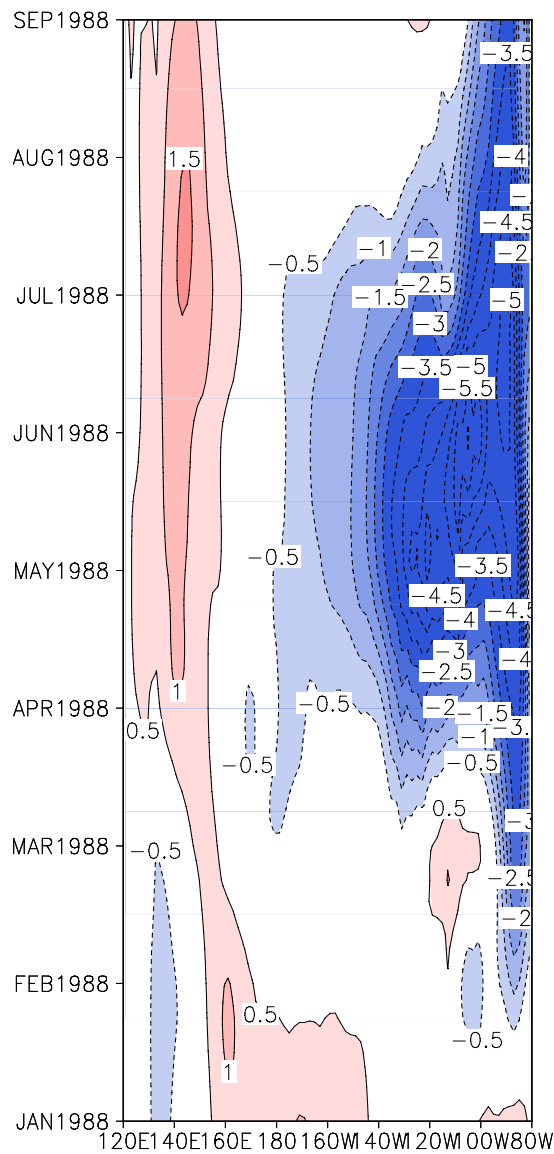
Identifying the Coupled Modes

- Forecast Environment
- Analogue Approach
 - Heat Content/D20C Analogues Don't Work

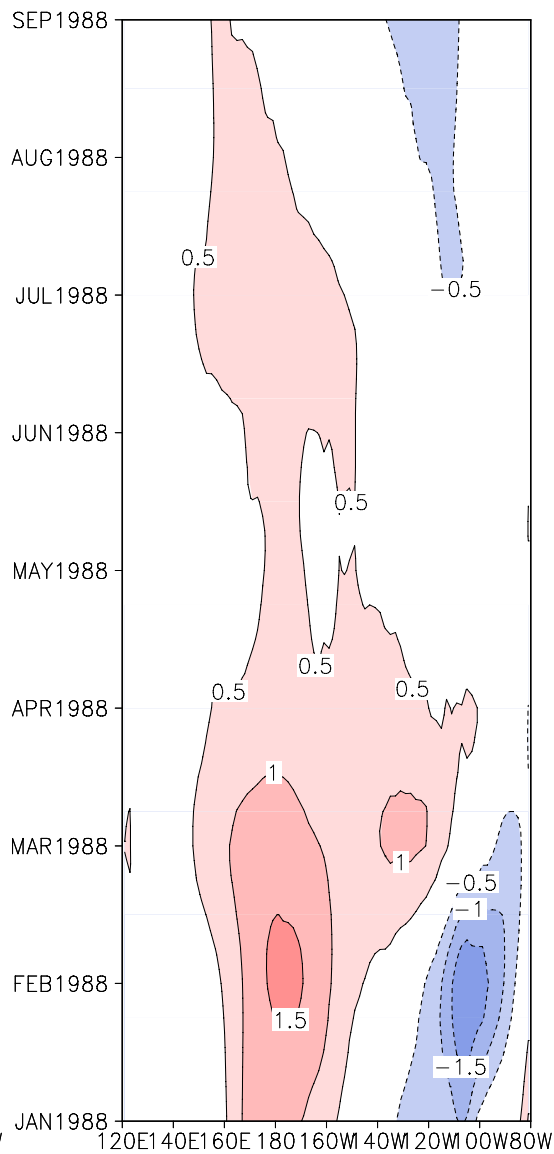
Coupled Modes of Coupled Model are Not the Same as the Observations
 - Use Long Simulation to Identify “Best Fit” SST Evolution (9 Months)

Relate Analogue “Initial State” to Observed Initial State

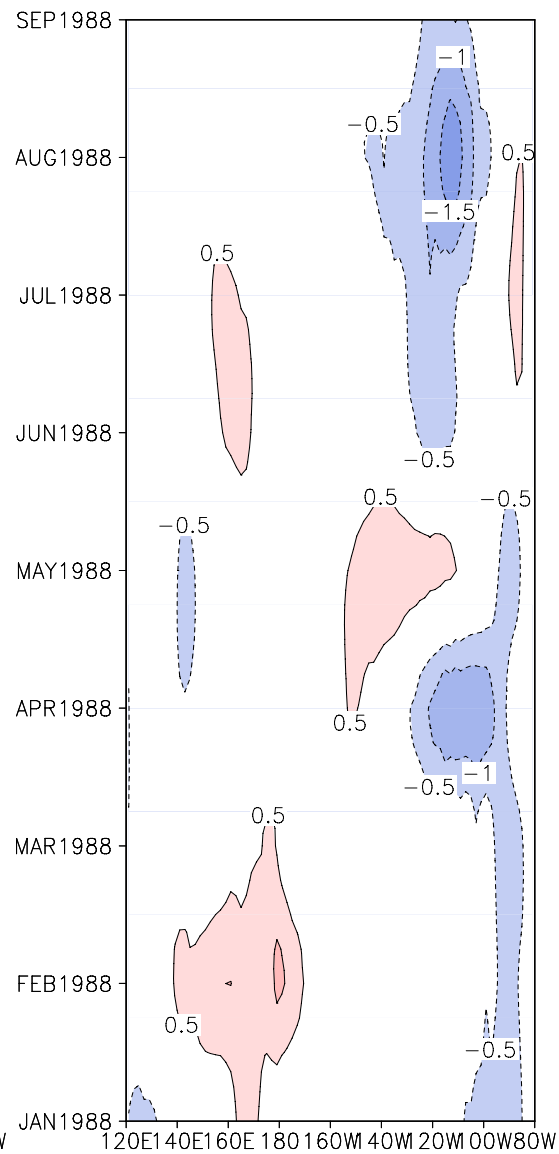
“Initial Condition” D20C Analogues Do Not Work



SSTA GODAS

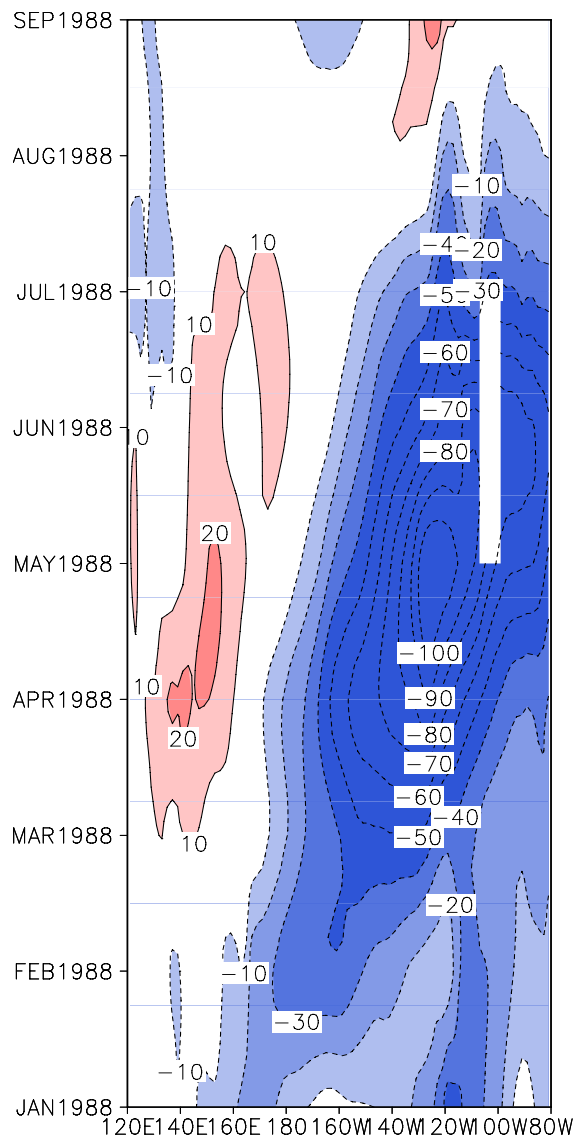


SSTA Forecast

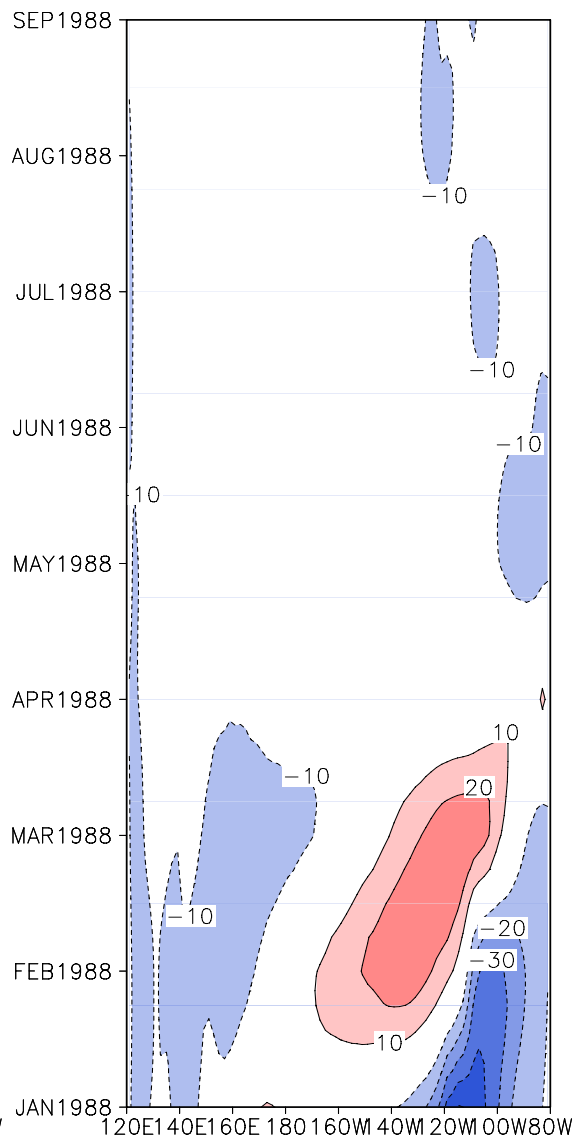


SSTA: Best D20C Analogue

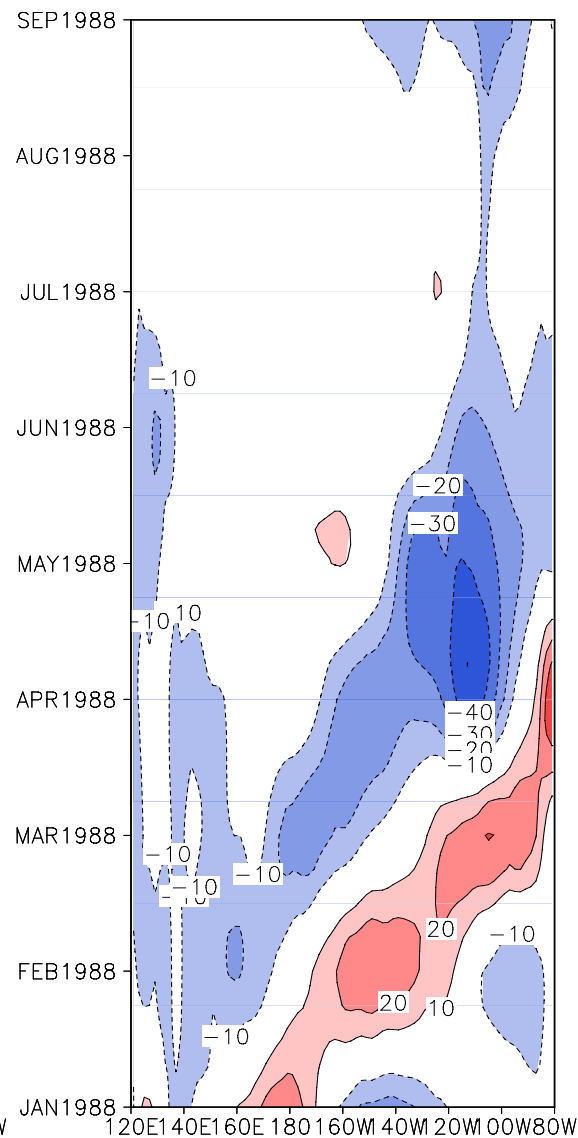
“Initial Condition” D20C Analogues Do Not Work



D20C GODAS

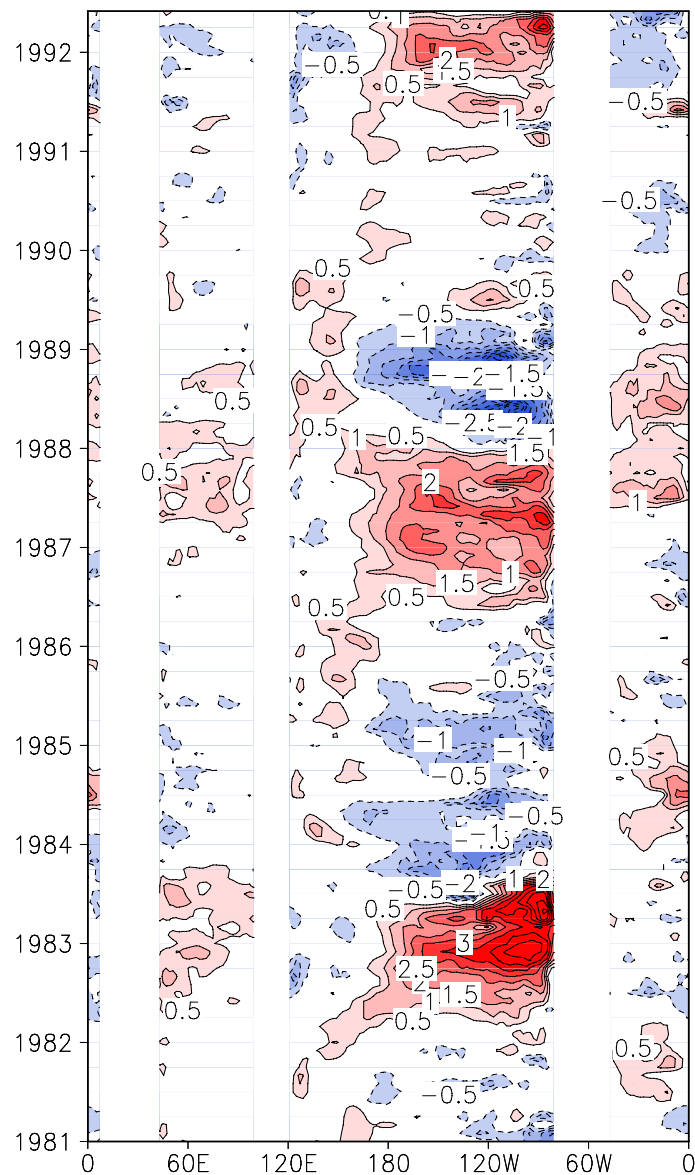


D20C Forecast

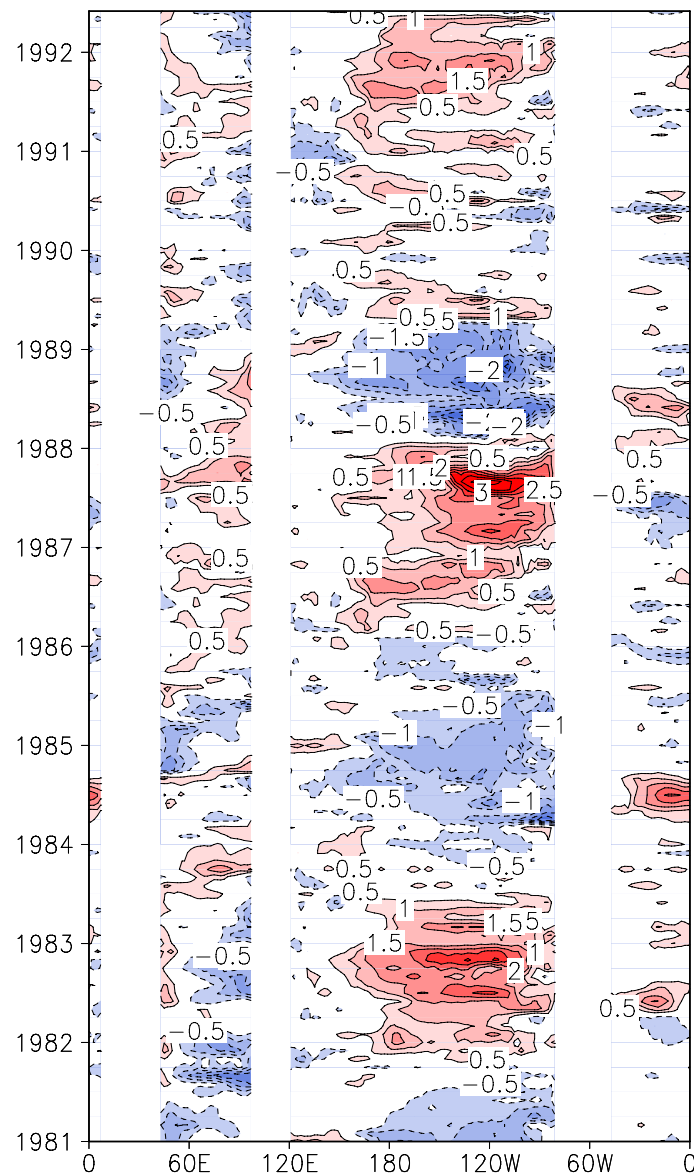


D20C: Best D20C Analogue

Forecast Evolution Analogues Do Work

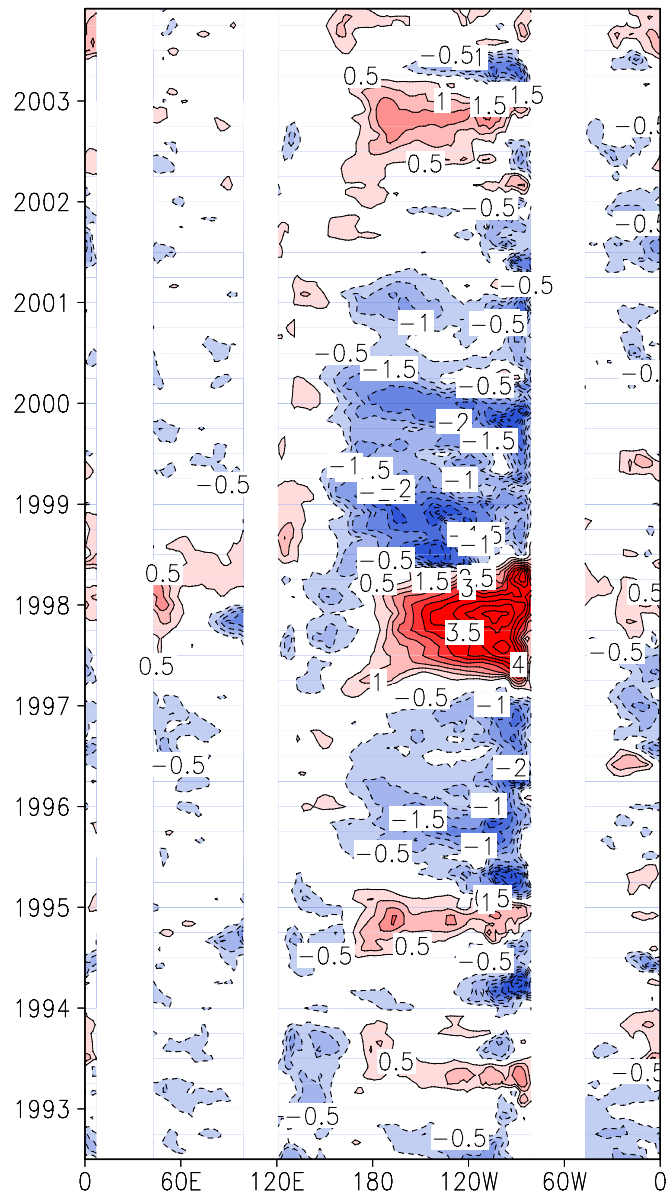


GODAS SSTA

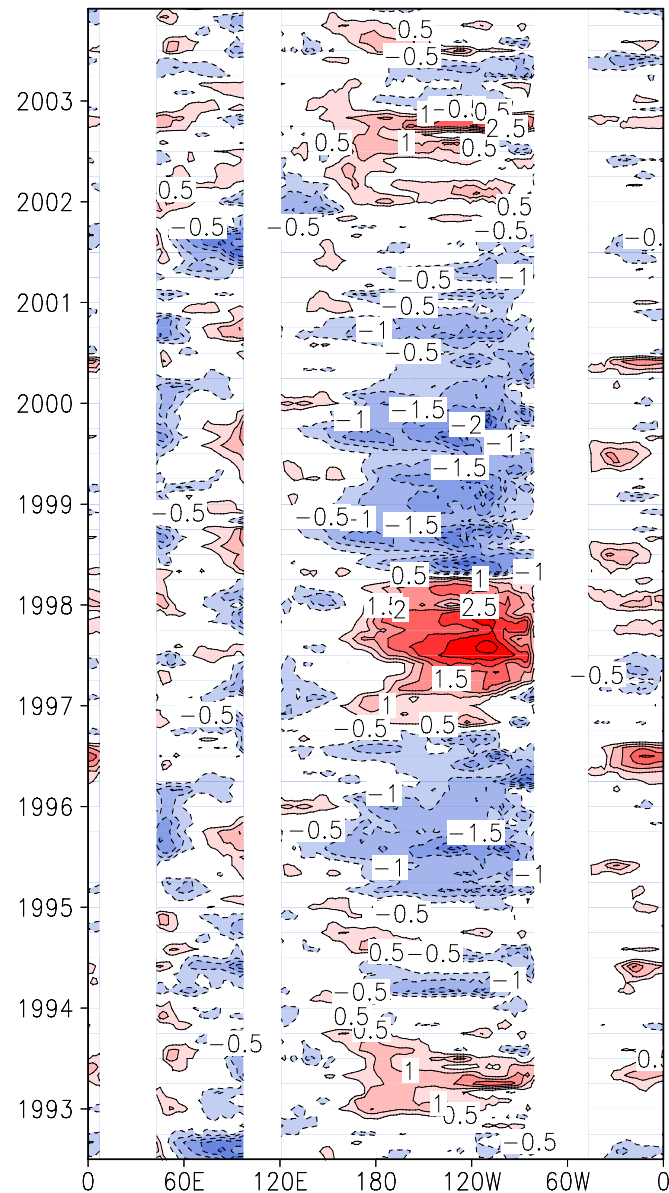


SSTA: Best SST Evolution Analogue

Forecast Evolution Analogues Do Work

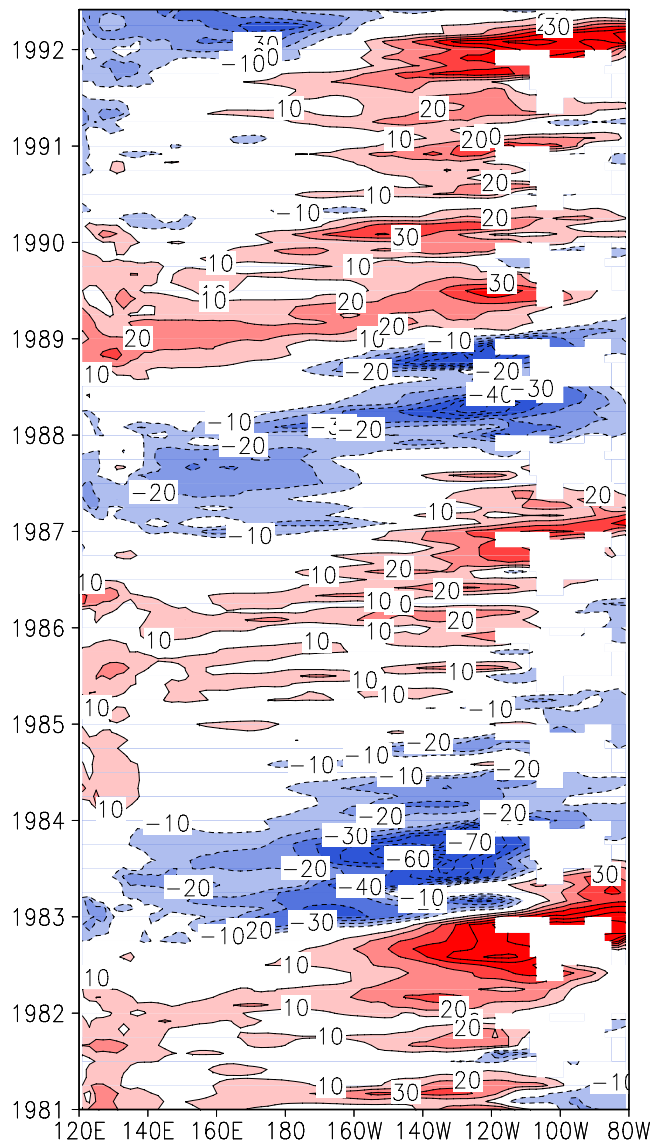


GODAS SSTA

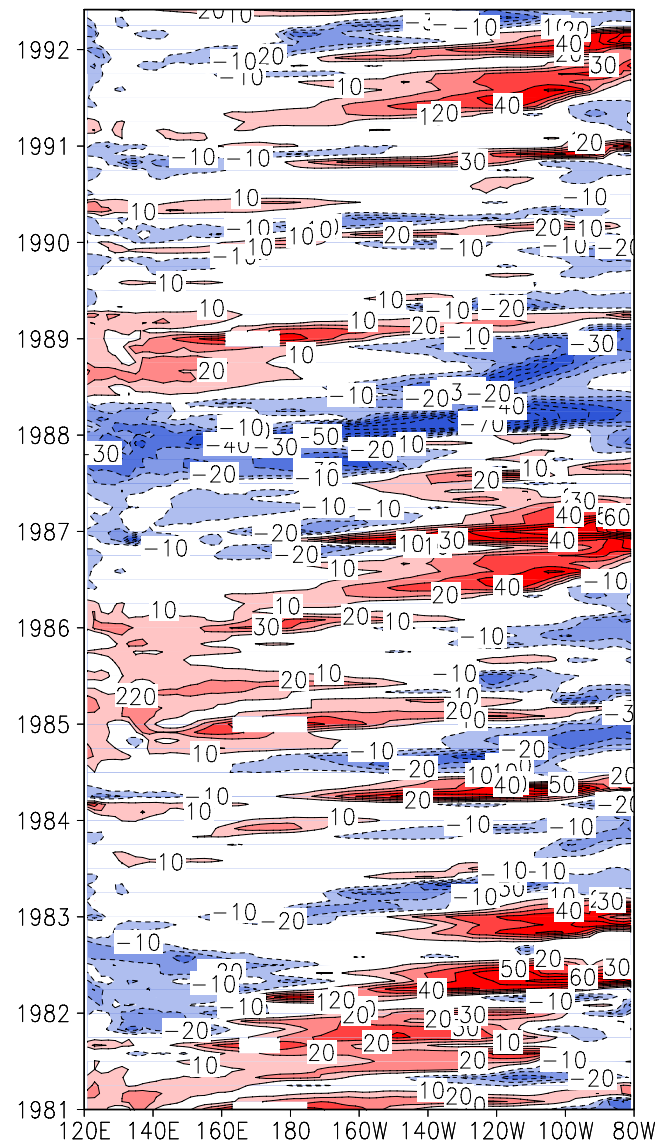


SSTA: Best SSTA Evolution Analogue

Forecast Evolution Analogues Do Work

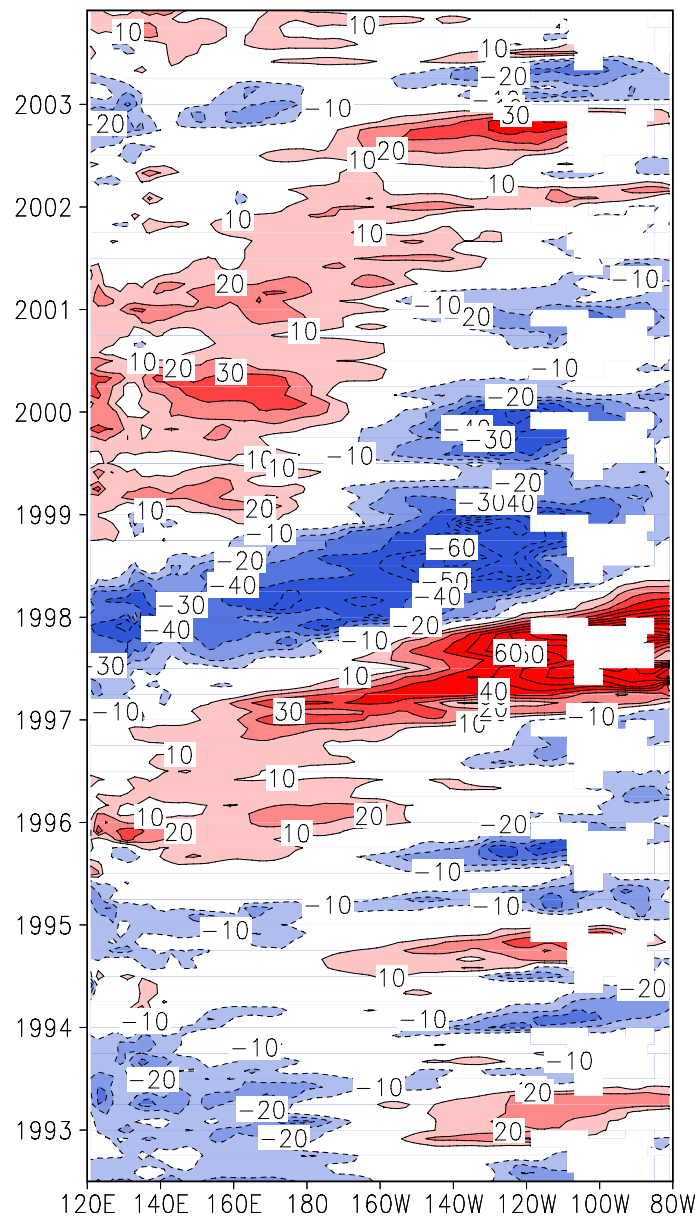


GODAS D20C

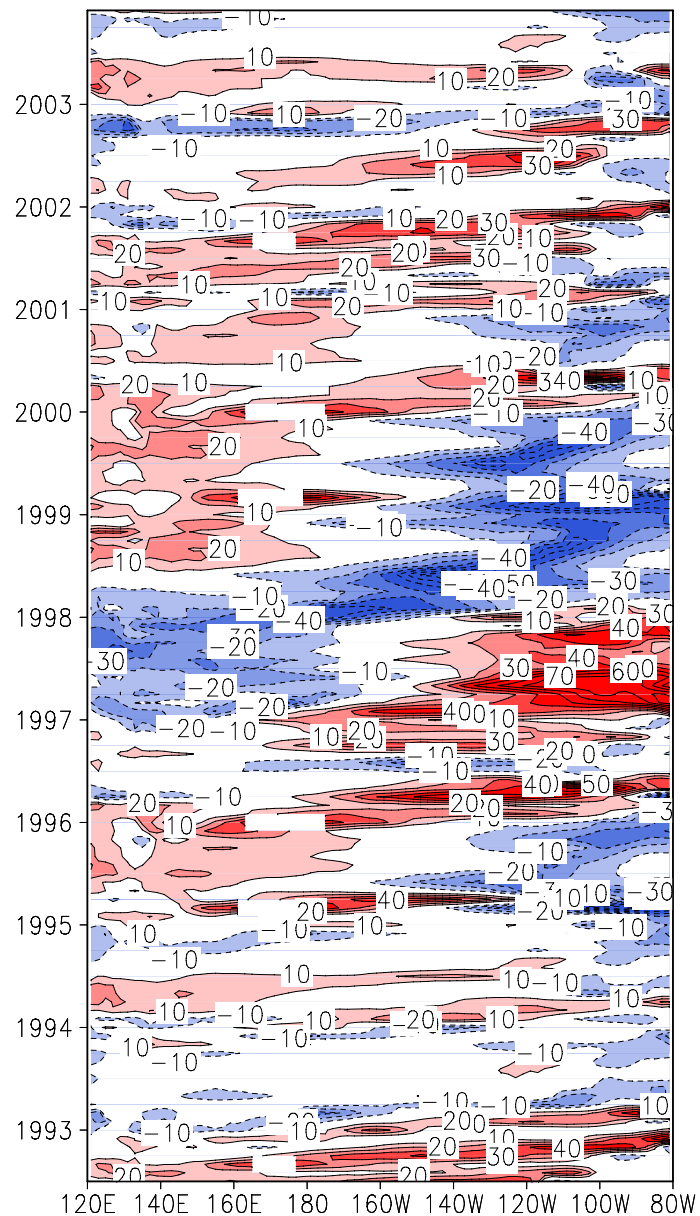


D20C: Best SSTA Evolution Analogue

Forecast Evolution Analogues Do Work



GODAS D20C

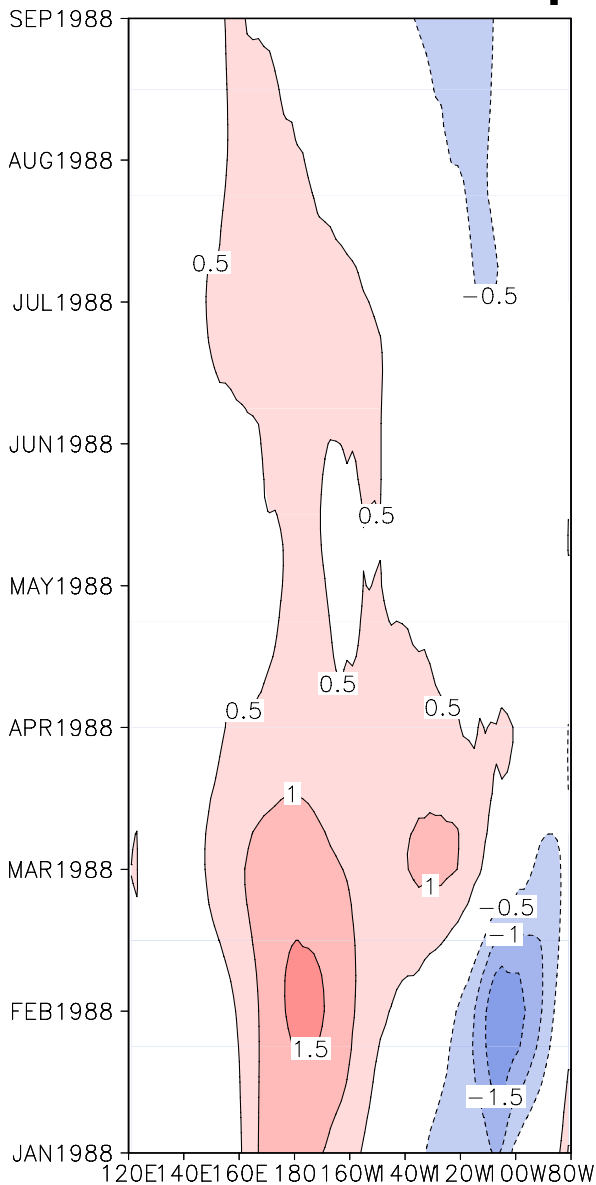


D20C: Best SSTA Evolution Analogue

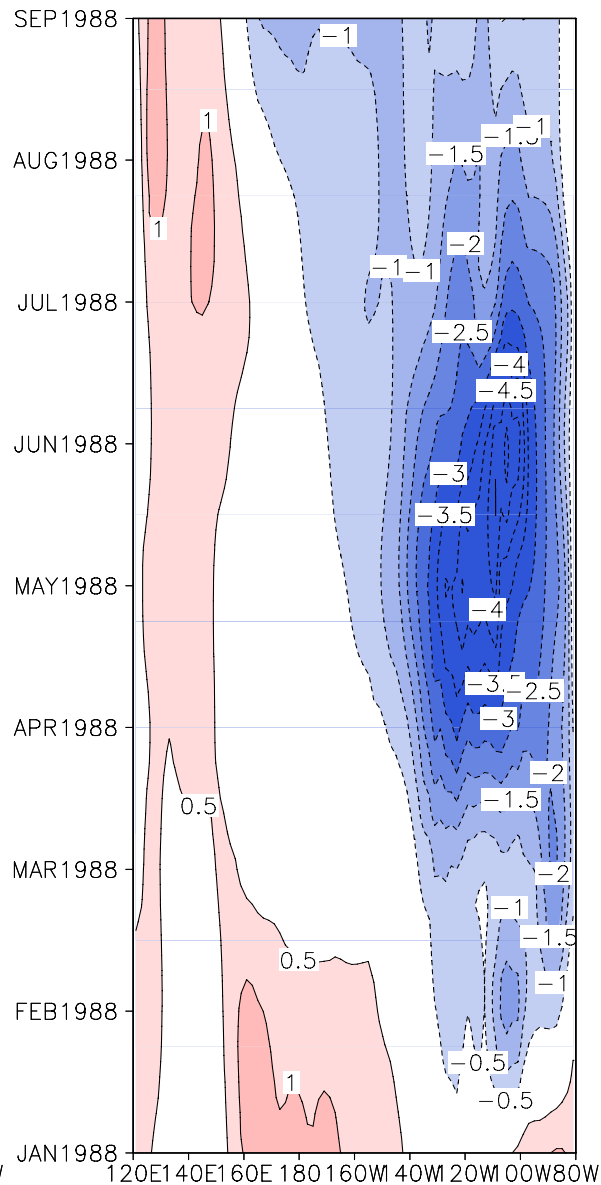
Initializing with the Coupled Modes

- Use Long Simulation to Identify “Best Fit” SST Evolution (9 Months)
- Relate Analogue “Initial State” to Observed Initial State
 - Singular Value Decomposition
- Project, Reconstruct, Re-Forecast (Anomaly Initialization)

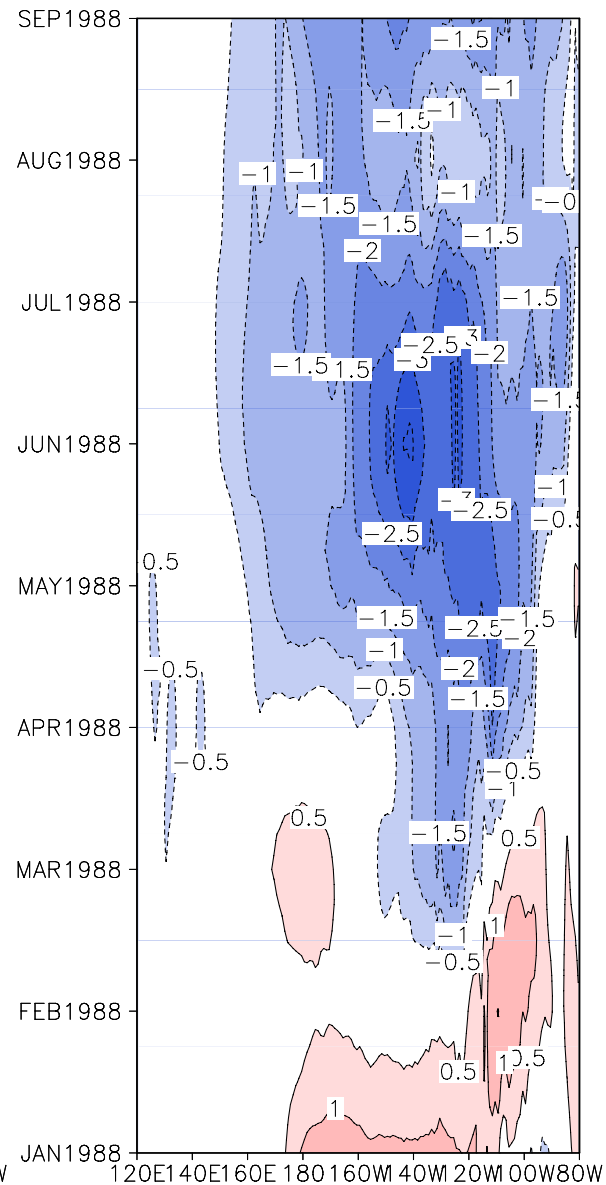
Equatorial Pacific SSTA Forecast



CFS Control

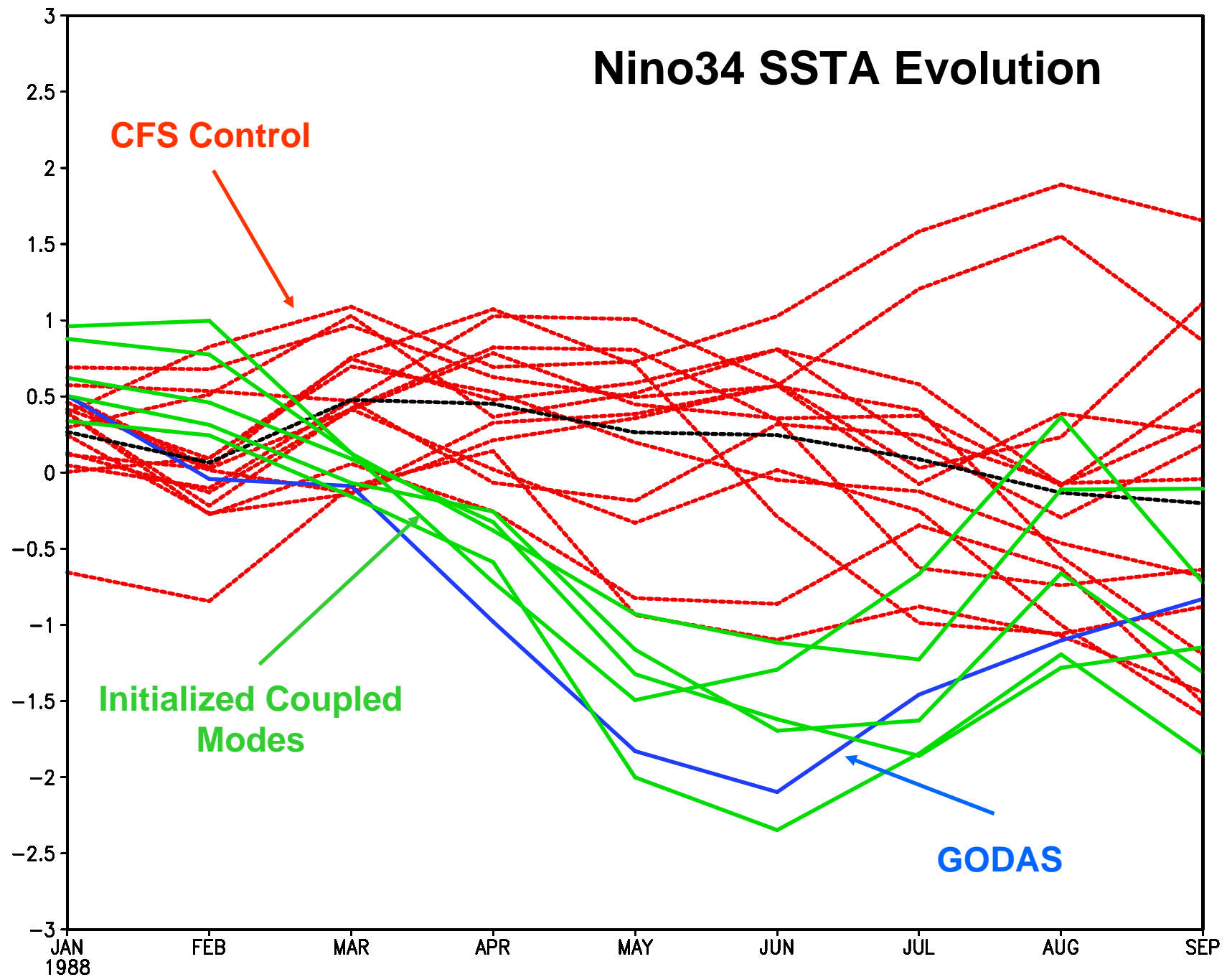


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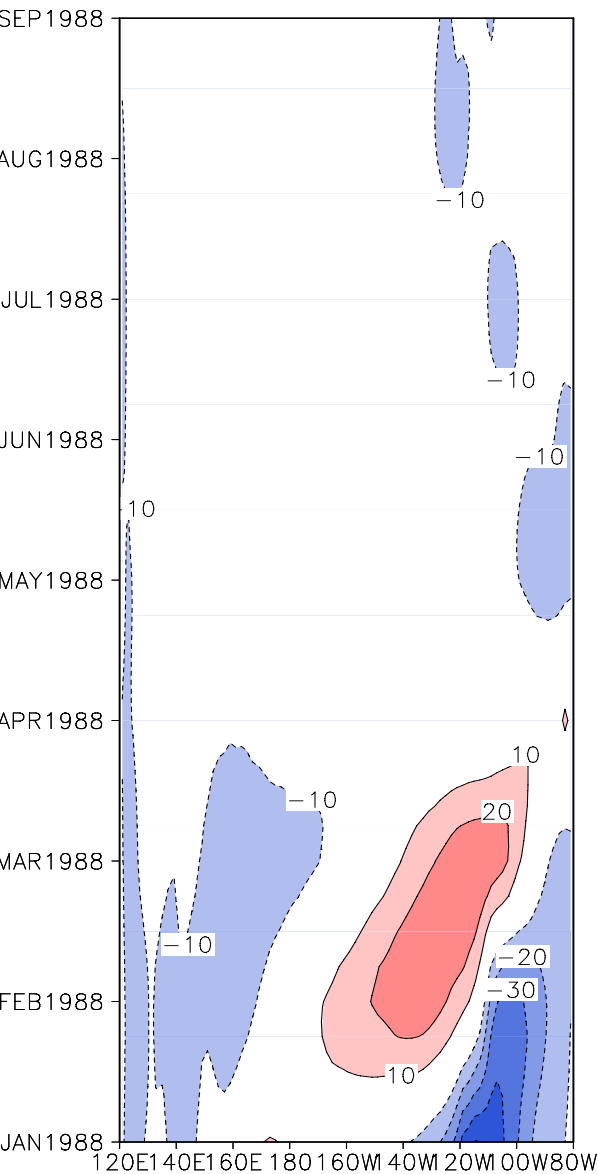


**Initialized Coupled
Modes**

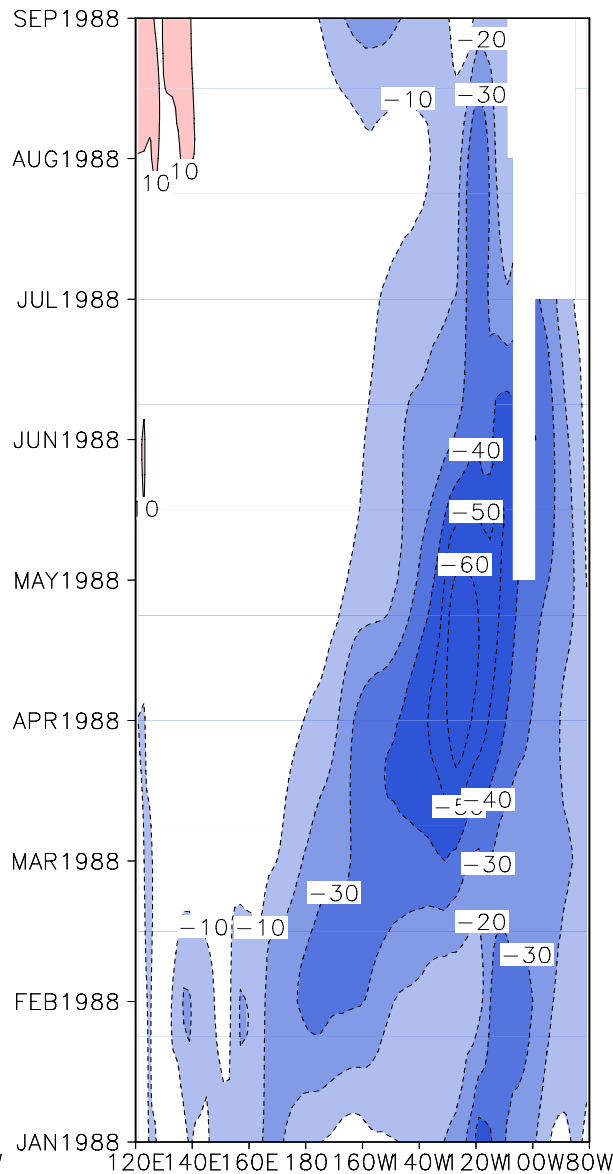
Nino34 SSTA Evolution



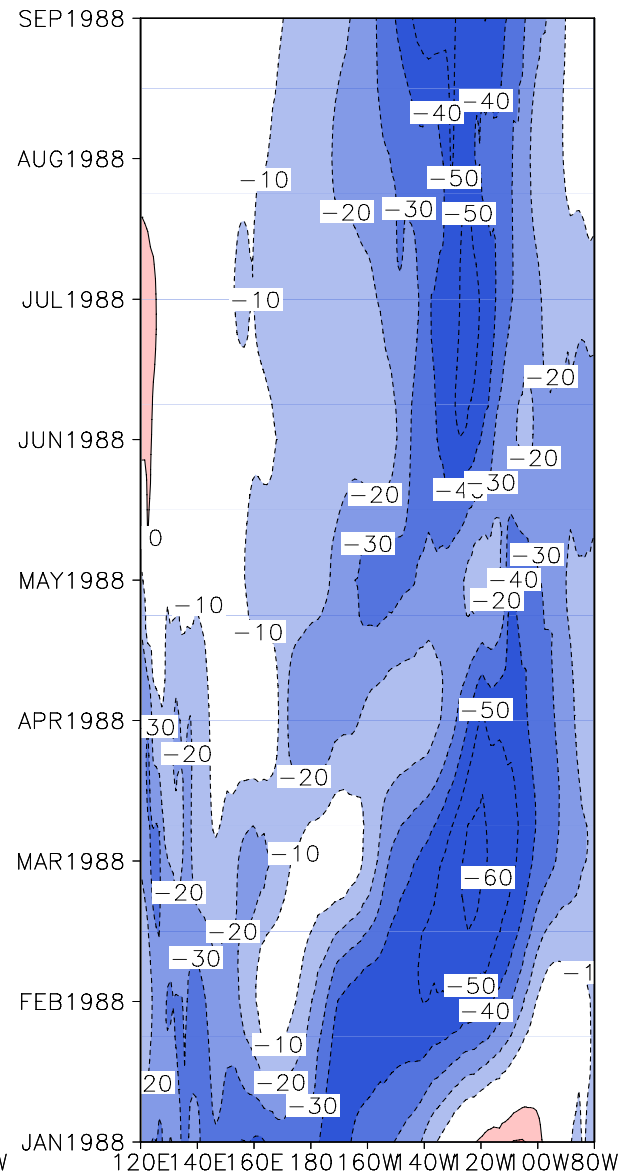
Equatorial Pacific D20C Forecast



CFS Control

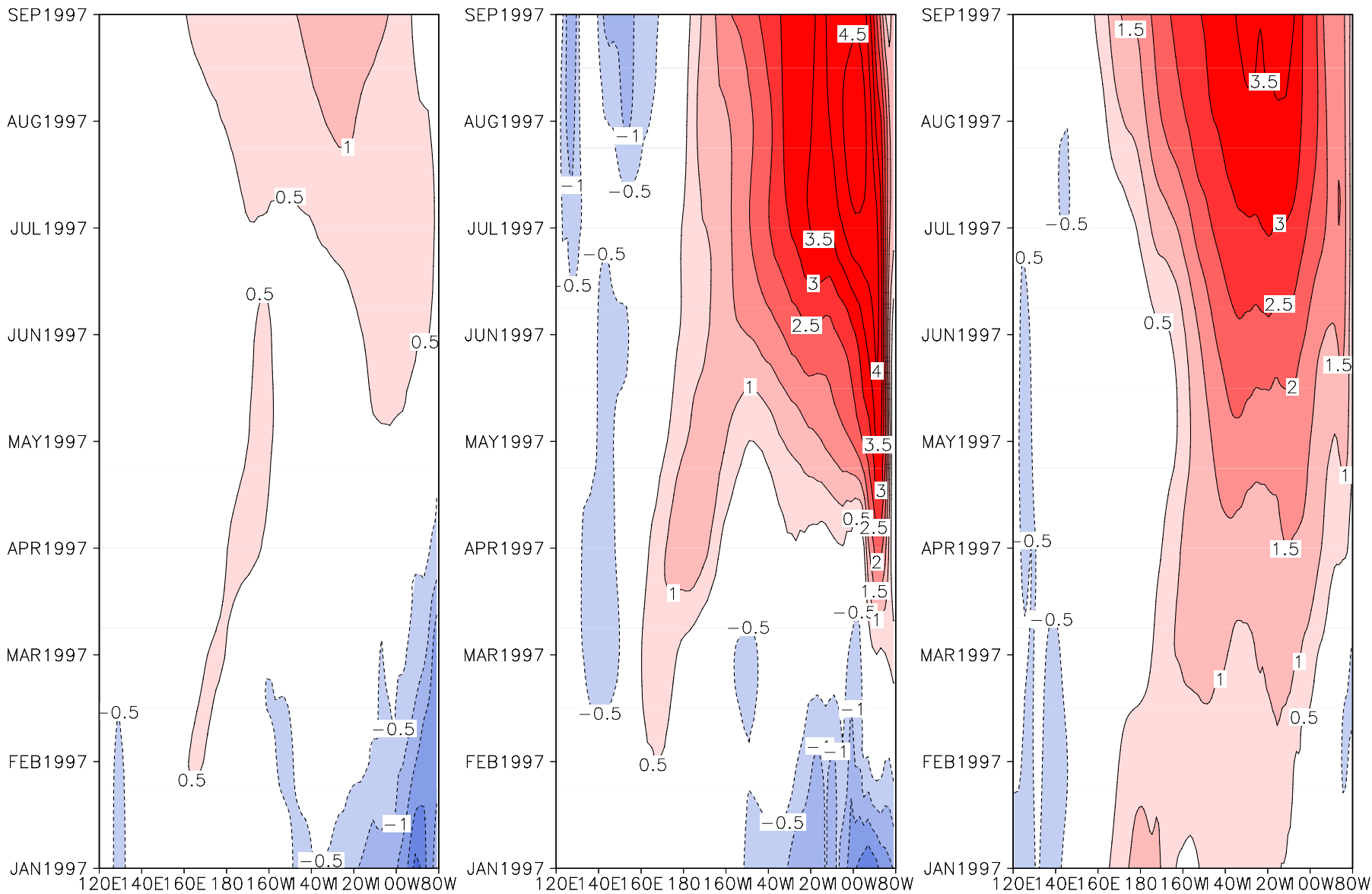


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**Initialized Coupled
Modes**

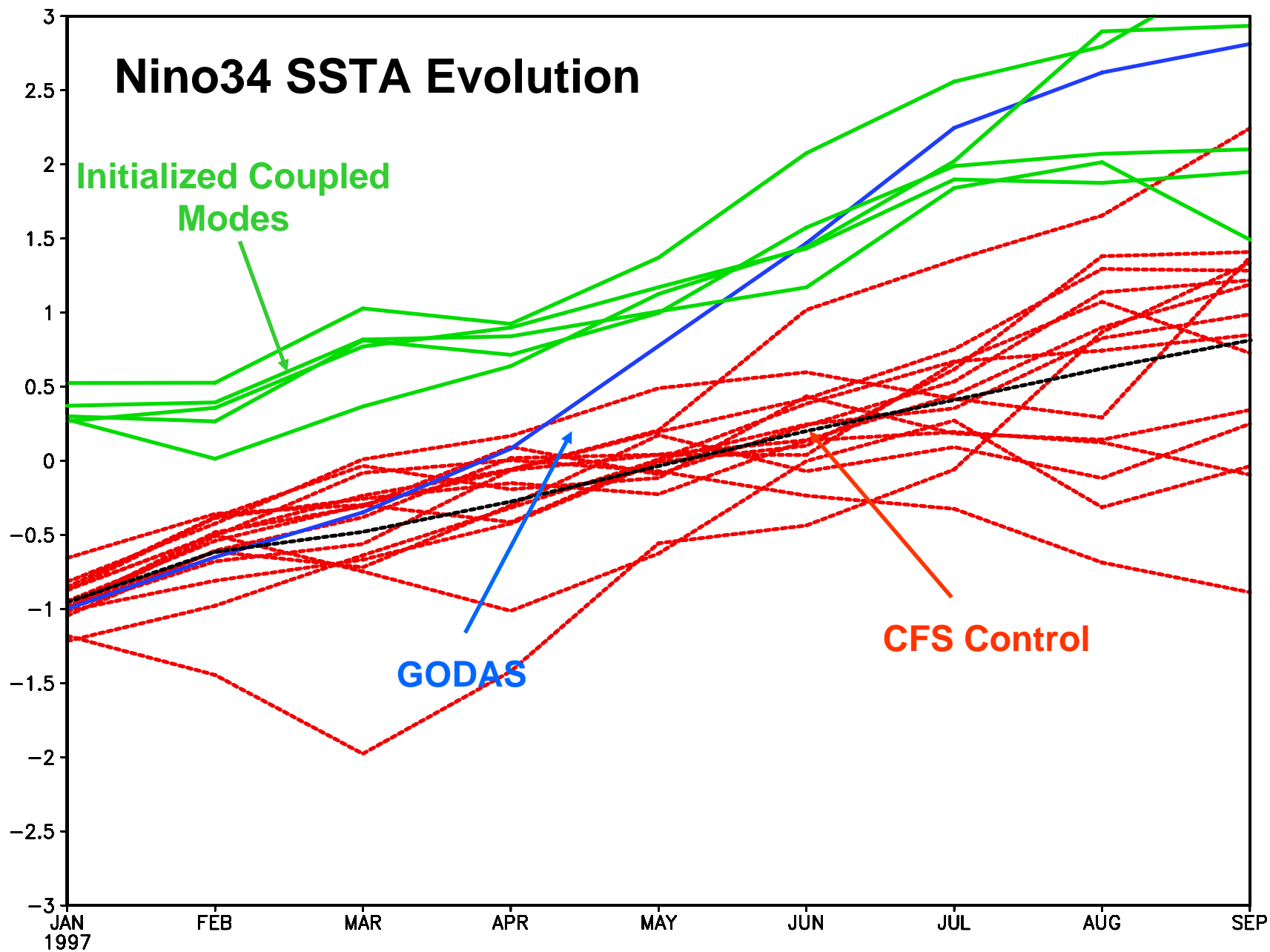
Equatorial Pacific SSTA Forecast



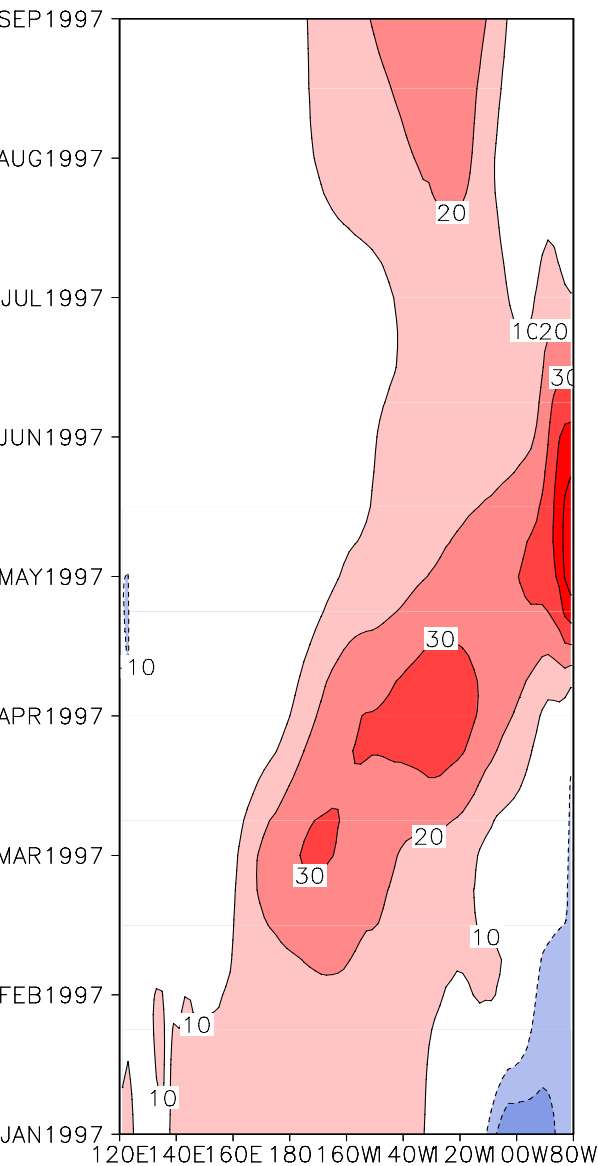
CFS Control

GODAS

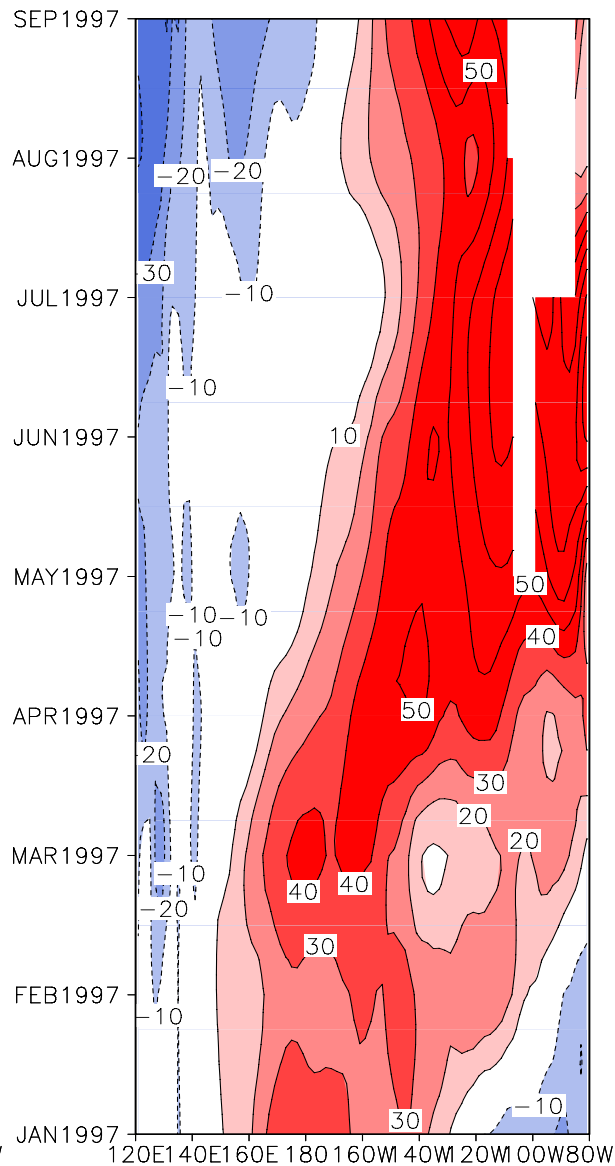
**Initialized Coupled
Modes**



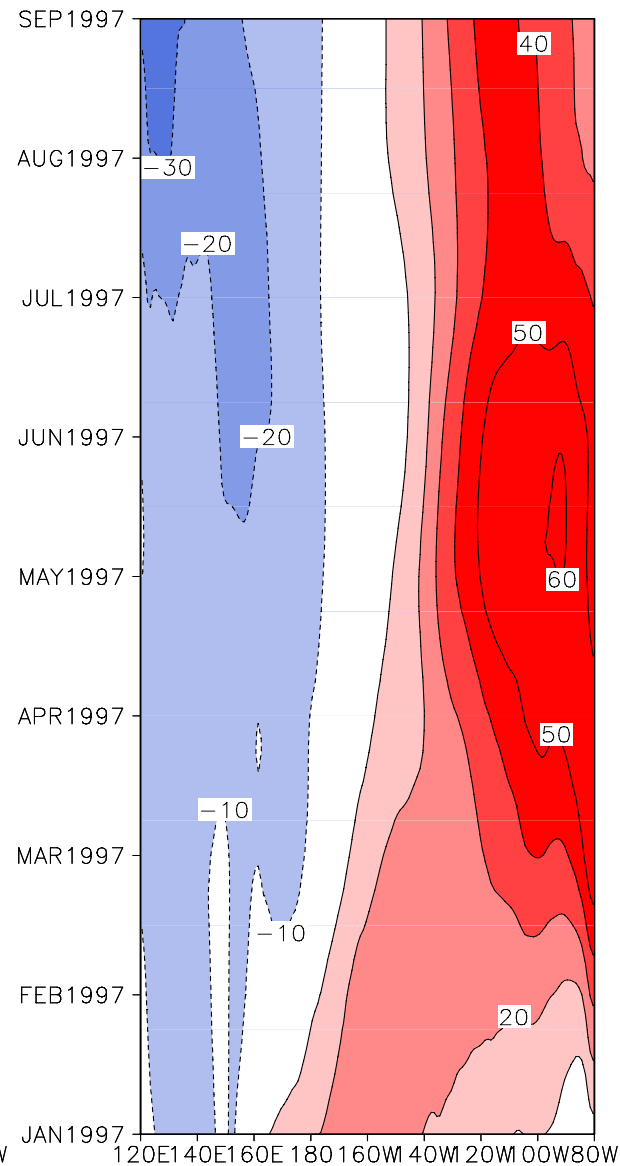
Equatorial Pacific D20C Forecast



CFS Control



GODAS



**Initialized Coupled
Modes**

Conclusions

- Anomaly Initialization Not Much Help
- Coupled Modes in Observations are not the Same as the Coupled Modes in the Model
 - ENSO Precursor, D20C Analogues Don't Work
- SSTA Evolution Analogues Show Promise
 - Need More Longer Simulations (Easy)
 - Need Many More Forecast Tests (Difficult)
- Predictability Issues
 - WWB, Ensemble Size
- Expand the Approach to the Coupled System
 - Blending or Nudging